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STUDY OF THE BEHAVIOUR OF HYBRID NANO JUTE FIBER COMPOSITE UNDER IMPACT LOADS

K. VISWANATH ALLAMRAJU

Department of Mechanical Engineering, Institute of Aeronautical Engineering, Dundigal, Hyderabad, India

ABSTRACT

In this paper presented the behavior of nano jute fiber composite under impact loads by varying percentage of weight fractions of jute fiber, as interlayer of glass fiber epoxy composite. Impact strength of the composite is the requirement to know the ability of the material under impact loads. The ratio of glass fiber and epoxy resin is 1:1. Hand la up method is employed for fabricating the samples and trimmed them under ASTM D 256 standards for experimentation. It is observed that the impact strength and hardness of composite is increased after utilizing the nano jute fiber composite than pure glass fiber epoxy composite.

KEYWORDS: Polymer Matrix Composite, Jute Fiber, Impact Strength & Hardness Number

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Original Article

INTRODUCTION

The Jute fiber can be utilized for automobile parts such as door panels, seatbacks, head liners, dash boards and trunk liners; for building components such as doors, windows, wall partitions, etc. Many researchers had studied the damping behavior of Jute fiber under various percentages of weight fractions of Jute fiber. Sometimes, nano particles increase the mechanical properties remarkably, when added to the parent materials [1-8]. The advantages of Jute fiber composites are: Weight is low, requirement of raw material is low, cheaper compared to other composites, optimized mechanical properties can be obtained, it is having good physical properties, good resistance to moisture, available in semi finished and finished state etc. Jute fiber can also be used for railway transport sector [9-10]. Mechanical properties of jute fiber were studied and compared the results with polyester and epoxy resins. Strength of jute fiber with epoxy resin was observed more than the polyester matrix jute fiber [11]. The study of natural fiber reinforcement was due to its abundant availability in wide variety [12-17]. In this paper, presented impact strength and Hardness of nano jute fibre embedded in a 1:1 glass fiber and epoxy resin matrices. The experiments are conducted by taking the samples based on ASTM D 256 standards in relation to the applications where impact loads are prominent.

EXPERIMENTAL SETUP

The raw materials used in this research work are as follows: Jute fiber, epoxy resin, hardener, Teflon sheet, silicone spray, wooden mould and miscellaneous items. The equipment used are weighing scale, cloth, stirrers, measuring jar, universal testing machine. In this study, samples of laminates are made by using hand lay-up method. The technique used in this investigation is employed due to its simplicity and availability of the items. The mould release spray is applied at the inner surface of the mould wall for easy removal. The jute fibers with different fiber percentage (i.e. 6 to 10 wt %) are mixed with matrix material consisting of epoxy resin and hardener

in the ratio of 10:1 by the simple mechanical stirring. Five samples are utilized for testing the both Impact and hardness. Heating gun is used for removing the air bubbles and for better homogeneity. Pressure is then applied from the top and the mould is allowed to cure at room temperature for 24 hrs. During the application of pressure some polymer squeezes out from the mould. After one day the samples are taken out of the mould, cut into different sizes for experimentation.

IMPACT TEST

The tension test is performed on all the five samples as per ASTM D 256 test standards. Charpy Impact testing machine (micro testing machines Ltd) is utilized for observing the load absorption in J/mm^2 of the samples. A sudden load is applied on the specimens by Charpy striker. The maximum strength is observed at the percentage of 9% weight of nano jute fiber and minimum strength is observed at 6% weight of nano jute fiber.

HARDNESS TEST

The specimen is positioned under the anvil of the MTM hardness tester, the load and the ball indentor size are based on the standards until the dial indicator reaches the maximum and comes to the stability of the indicator. The depth of indentation is converted to hardness number. Total five specimens are tested to observe the hardness numbers of at various nano jute fiber embedding. The maximum strength is observed at the percentage of 9% weight of nano jute fiber and minimum strength is observed at 6% weight of nano jute fiber.

RESULTS AND DISCUSSIONS

The impact strength is increased by the increase of fiber adding up to 9 wt % and then decreased at 10 wt% i.e. 0.85 J/mm^2 to 0.75 J/mm^2 respectively. Increasing strength is due to increasing of interfacial bond strength between jute fiber and glass fiber reinforced epoxy composite, with an increase in the % of jute fiber is due to impregnation.

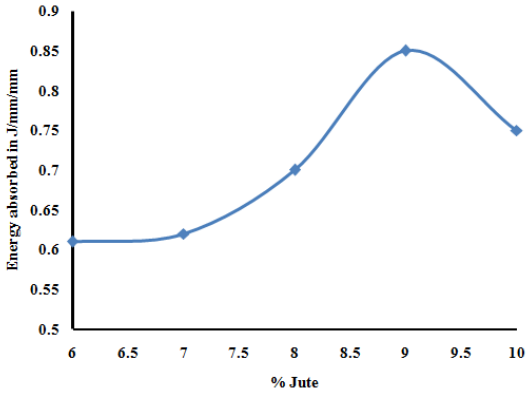

Figure 1: Variation of Energy Absorbed values with various % Jute Fiber Contents

The sudden drop in impact strength is due to failure of specimens and the arrest points correspond to breakage and pull out of individual fibers from the resin matrix. This is due to higher stiffness of jute composite and the improved adhesion between the matrix and the fiber. This decrease is attributed to the inability of the fiber, irregularly shaped, to support the stresses transferred from the polymer matrix and poor interfacial bonding generates partitioned spaces between fiber and matrix material and as a result generates weak structure. The experimental results of impact test and hardness tests are shown in Figure 1 and 2. From 6% to 10% shows the nonlinear behavior of nano jute fiber composite embedded in glass fiber reinforced epoxy composite. At 6%, energy absorbed is 0.61 J/mm^2 and at 9%, energy absorbed reading is 0.85

J/mm^2. The improvement of impact strength from 6% to 9% is 39.3%.

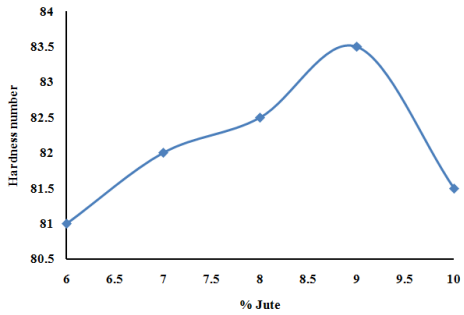

Figure 2: Variation of Hardness with Different % Jute Fiber Contents

The observed hardness numbers at 6% and 9% are 81 and 83.5. The improved hardness number from 6% to 9% addition of nano jute fiber is 3.09%.

CONCLUSIONS

Jute fibre reinforced epoxy composites are prepared by using a fabrication method known as hand-lay-up process. The raw material passes through different stages such as dissolving, preparation of the solution, formation of reinforcement, and drying to get the composite block as per ASTM standards. As these formations of composite are made into different proportions in order to get the better % composite. The proper mixing of composite in which they are being placed in a wooden box, closed with top and bottom. The experiment is conducted in different machines and as per the machine, specific specimen is prepared. From these tests, the changes are measured and explained as density decreases with increasing jute fiber content due to the less thickness in the fiber and due to the reduction in the void numbers. The impact strength is increased by the increase of fiber loading up to 9 wt%, and then decreased at 10 wt%. The sudden drop is due to failure of specimens and the arrest points correspond to breakage and pull out of individual fibers from the resin matrix. The impact and hardness strengths for Jute fibre are observed through experimentation which are found better than the impact and hardness strengths of banana fibre and hemp fibers.

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